

**AE-05-05      ADVANCED TECHNOLOGY AND SYSTEMS ASSESSMENT**

AKB	WATER USE INFORMATION SYSTEM	JF FLETCHER	\$ 100K
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**AF-10-25      GAS COOLED FAST BREEDER REACTOR DEVELOPMENT**

AKS	GCFR STRUCTURAL MATERIALS	LD BLACKBURN	\$ 20K
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**AG-40-10-05      LWR FUEL CYCLE**

ALA	HYBRID FUEL FABRICATION	DW BENNETT	\$ 750K
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**AR-05-10-02      DEFENSE WASTE MANAGEMENT**

AKC	ACID DIGESTION (LOW LEVEL)	CR ALLEN	\$ 1500K
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**AT-15-30-31      FUSION REACTOR MATERIALS**

AKH	FUSION ALLOY DEVELOPMENT	GL WIRE	\$ 750K
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**AT-15-30-33      FUSION REACTOR MATERIALS**

ALT	SOLIO TRITIUM BREEDER DEVELOPMENT	ET WEBER	\$ 200K
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**AT-15-30-34      FUSION REACTOR MATERIALS**

AKJ	IRRADIATION EFFECTS ANALYSIS	DG DORAN	\$ 700K
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**HA-01-03-04      REGIONAL ASSESSMENT**

ALR	OTT WATER RESOURCE STUDIES	JF FLETCHER	\$ 25K
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**SPECIAL REQUESTS      CLINCH RIVER BREEDER REACTOR PROJECT**

EBA	CRBRP REACTOR SYSTEMS THERMAL HYDRAULIC TESTING	WI THORNE	\$ 890K
EBC	CRBRP FUEL FAILURE MONITORING	JJ McCOWN	

SUBTOTAL	\$ 980K
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**SPECIAL REQUESTS      NUCLEAR REGULATORY COMMISSION**

EAA	SHIPPING CASK ANALYSIS	JF FLETCHER	\$ 120K
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QUESTS	OTHER		
CA		NATIONAL WASTE TERMINAL STORAGE PROGRAM	RJ CASH \$ 924K
		AND SPENT FUEL ENGINEERING	
CB		FUSION REACTOR SAFETY SUPPORT STUDIES	LD MOHLESTEIN 441
			SUBTOTAL 1365K
			TOTAL 7262K

**REACTOR CORE SUPPLY - TT NAGAMOTO**

HYBRID FUEL FABRICATION  
LOFT ADVANCED FUEL ROD INSTRUMENTATION  
DEVELOPMENT

DW BENNETT  
EM SHEEN

\$ 750K  
164

SUBTOTAL \$ 914K

**: CORE EVALUATION - CM COX**

SOLID TRITIUM BREEDER DEVELOPMENT

ET WEBER

\$ 200K

**: TECHNOLOGY - HH YOSHIKAWA**

WATER USE INFORMATION SYSTEM  
ACID DIGESTION (LOW LEVEL)  
FUSION ALLOY DEVELOPMENT  
IRRADIATION EFFECTS ANALYSIS  
GAS COOLED FAST REACTOR STRUCTURAL  
MATERIALS

JF FLETCHER  
CK ALLEN  
GL WIRE  
DG DORAN  
LD BLACKBURN

\$ 100K  
1500  
750  
700  
20

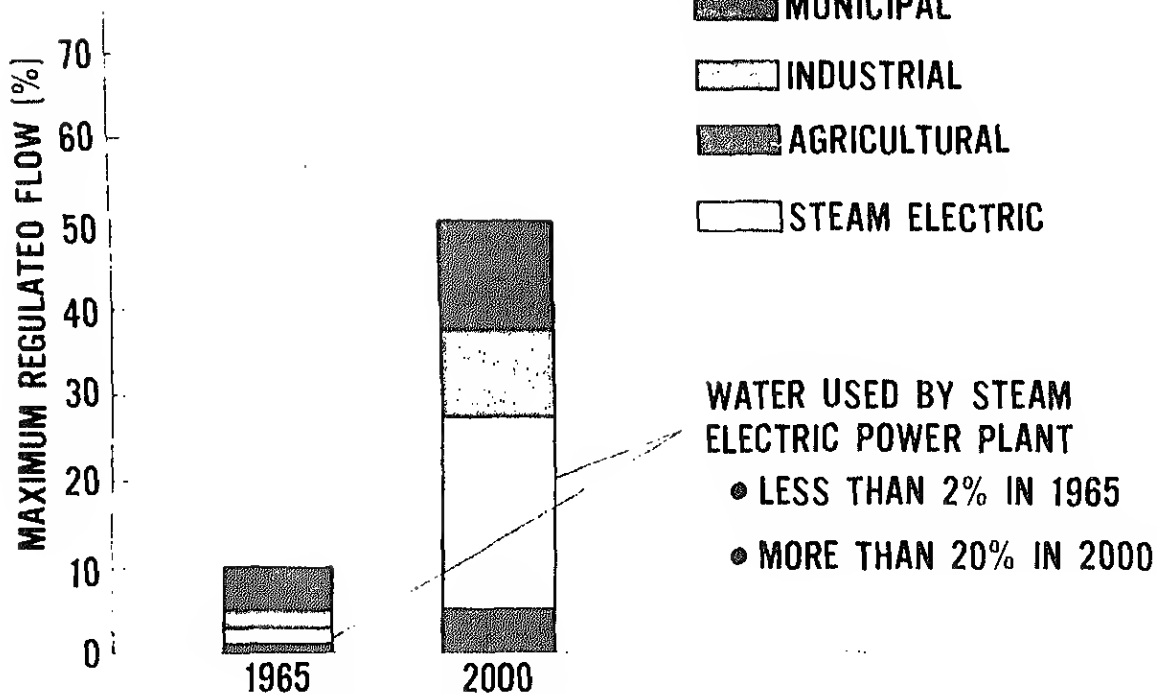
OTI WATER RESOURCE STUDIES  
SHIPPING CASK ANALYSIS  
LWR NEUTRON DOSIMETRY  
CRBRP REACTOR SYSTEMS THERMAL HYDRAULIC  
TESTING  
CRBRP FUEL FAILURE MONITORING  
NATIONAL WASTE TERMINAL STORAGE PROGRAM  
AND SPENT FUEL ENGINEERING  
FUSION REACTOR SAFETY SUPPORT STUDIES

JF FLETCHER  
JF FLETCHER  
WN McELROY  
WL THORNE  
JJ McCOWN  
RJ CASH  
LD MUEHLESTEIN

25  
120  
588  
890  
90  
924  
441

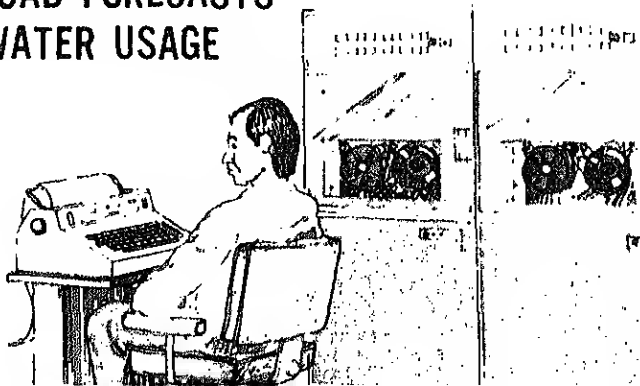
SUBTOTAL \$ 6148K

TOTAL \$ 7262K



## WATER USE INFORMATION SYSTEM

- INDIVIDUAL POWER PLANT CHARACTERISTICS
- REGIONAL HYDRAULIC DATA
- WATER RIGHTS
- REGIONAL LOAD FORECASTS
- REGIONAL WATER USAGE



## **OBJECTIVE**

Provide data and evaluations on water resource availability in support of the advanced cooling systems program.

## **SCOPE**

Develop and operate the computerized Water Use Information System. Perform national and regional water resource evaluations at DOE request.

## **RECENT TECHNICAL HIGHLIGHTS**

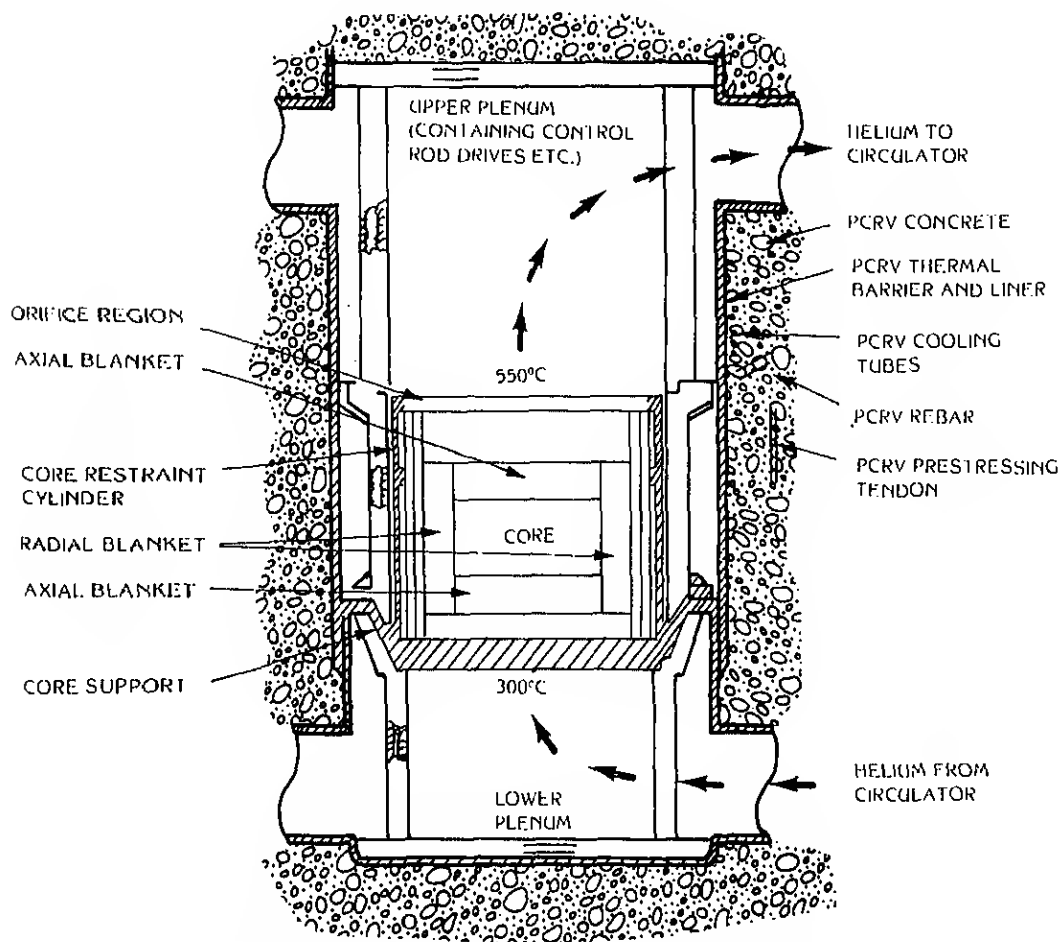
DND, an econometric predictive model for electricity demand, was completed and used in regional water resource evaluations.

A cursory water resources evaluation of national and regional water availability for power plant cooling was completed.

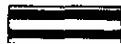
## **EXPECTED NEAR-TERM ACCOMPLISHMENTS**

An updated, detailed study of national and regional water availability for power plant cooling will be completed.

# CROSS SECTION OF GCFR DEMONSTRATION PLANT REACTOR CAVITY



STRUCTURAL  
STEEL



LAMINATED  
SHIELDING

**Manager:** L.D. Blackburn  
**Sub-Department:** Technology

**FY-81:** \$ 20K

**Customer:**  
**Organization:** DOE/RRT  
**Contact:** G.A. Newby  
**Program:** Gas Cooled Fast  
Breeder Reactor  
Development  
AF-10-25

## **OBJECTIVE**

Provide mechanical property data on irradiated and unirradiated materials to support the design, safety analyses, and operation of GCFR out-of-core components.

## **SCOPE**

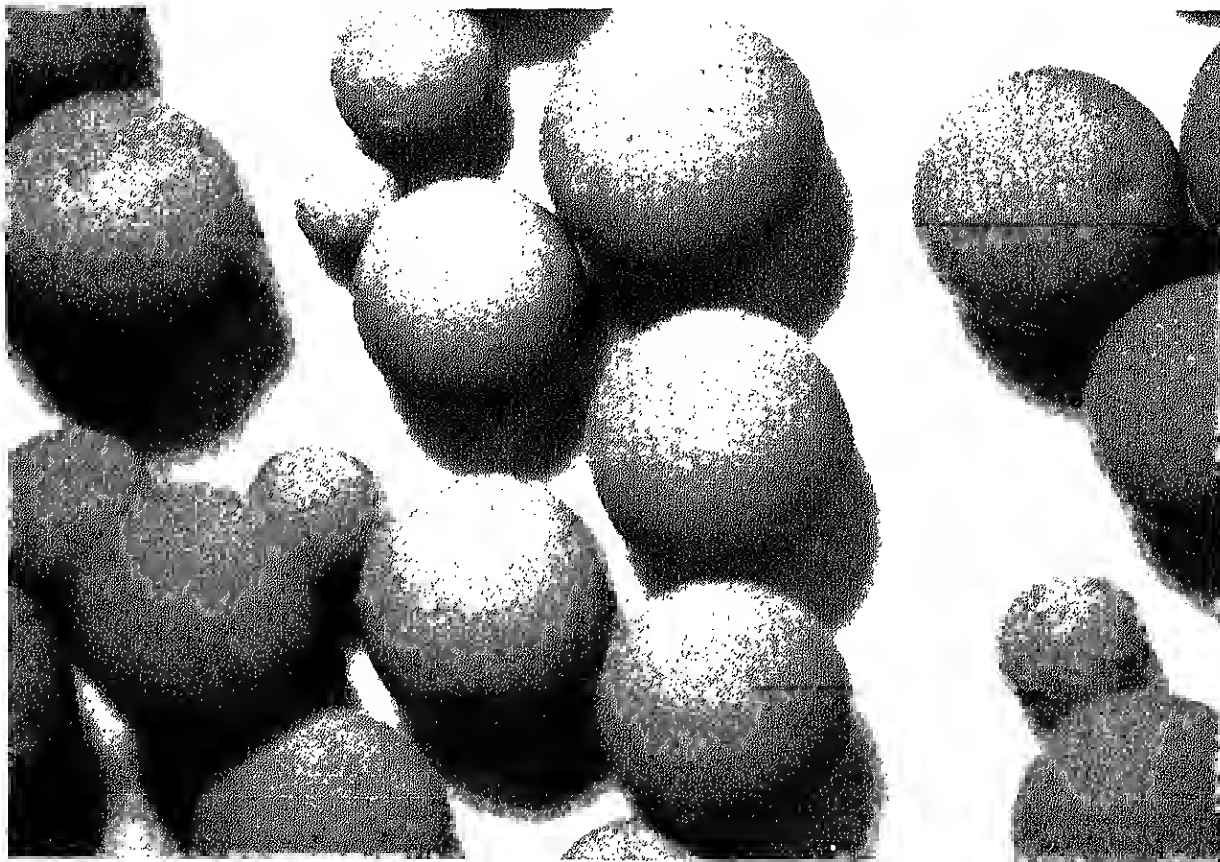
Conduct irradiations and testing to determine strength, ductility, fatigue crack propagation and fracture toughness of selected materials.

## **RECENT TECHNICAL HIGHLIGHTS**

EBR-II irradiation of three pins and postirradiation tension testing to determine high temperature fluence limits for 316 SS materials was completed.

Characterization of fatigue crack propagation in two ferritic steels, modified 9Cr-1Mo and HT-9, was completed.

## **GEL SPHERES**



**UNSINTERED ~40X**



**FY-81: \$ 750K**

**Contact:** W.W. Danard  
**Program:** LWR Fuel Cycle  
AG-40-10-05

## **OBJECTIVE**

Evaluate the equipment required for fabrication of breeder reactor pellet fuels from an alternate conversion source.

## **SCOPE**

Adapt equipment used to fabricate fuel pellets from mixed oxide powder to make fuel from gel-spheres produced by the internal gelation method.

Adapt as necessary automated analytical chemistry techniques, waste/scrap processing, and handling systems to accommodate gel/sphere processing.

## **RECENT TECHNICAL HIGHLIGHTS**

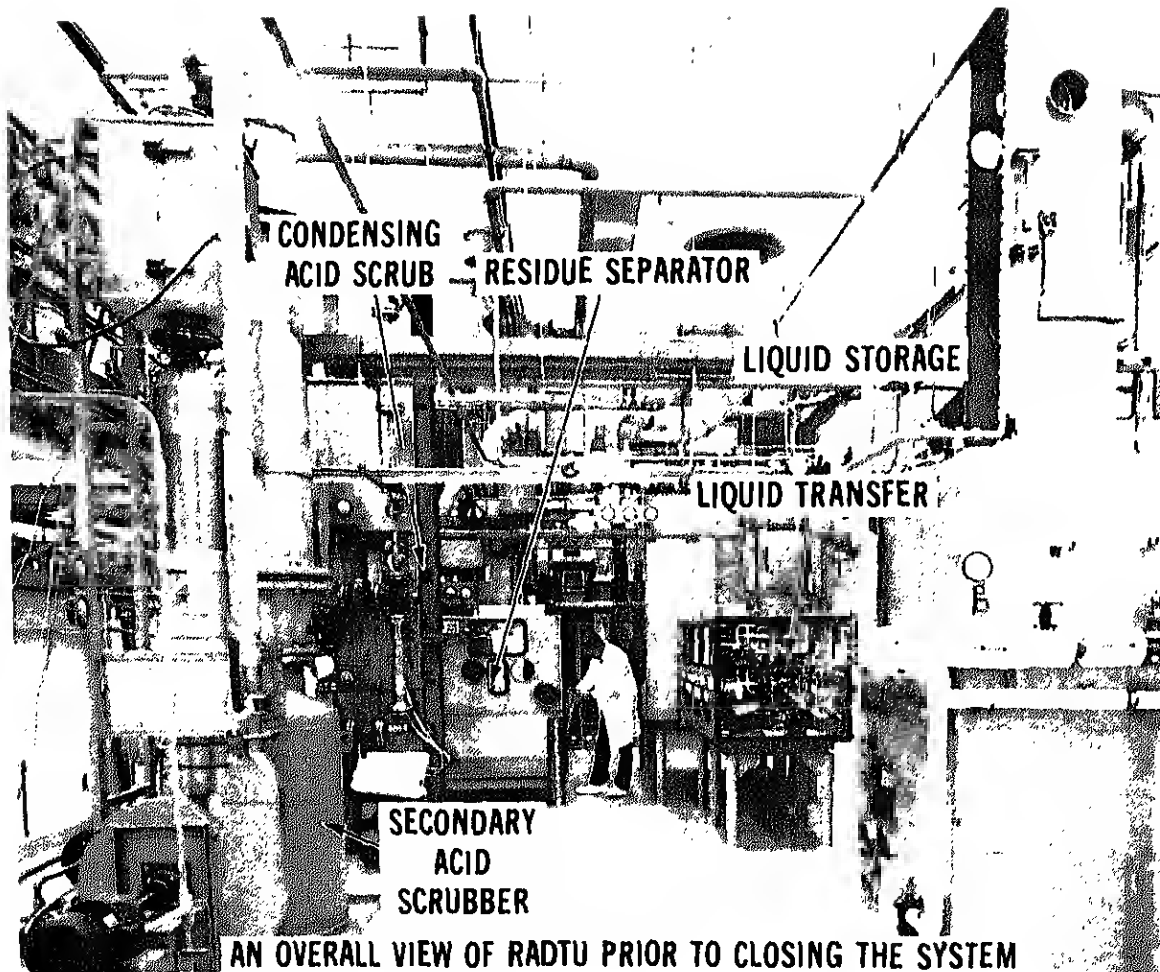
The first sample of gel-spheres was received and is being evaluated and analyzed.  
Press feeding system was designed and fabricated.

## **EXPECTED NEAR-TERM ACCOMPLISHMENTS**

Transporting and feeding tests will be conducted with spheres.

Press feed system will be demonstrated.

Cost comparison data will be established.



AN OVERALL VIEW OF RADTU PRIOR TO CLOSING THE SYSTEM

**Manager:** C.R. Allen  
**Sub-Department:** Technology

**FY-81:** \$ 1500K

**Customer:**  
**Organization:** DOE/RL  
**Contact:** G. Miskho/W.C. Johnson  
**Program:** Defense Waste Management  
AR-05-10-02-F

## **OBJECTIVE**

Process Z-plant transuranic waste and scrap. Demonstrate capability of acid digestion system to process various waste and scrap forms.

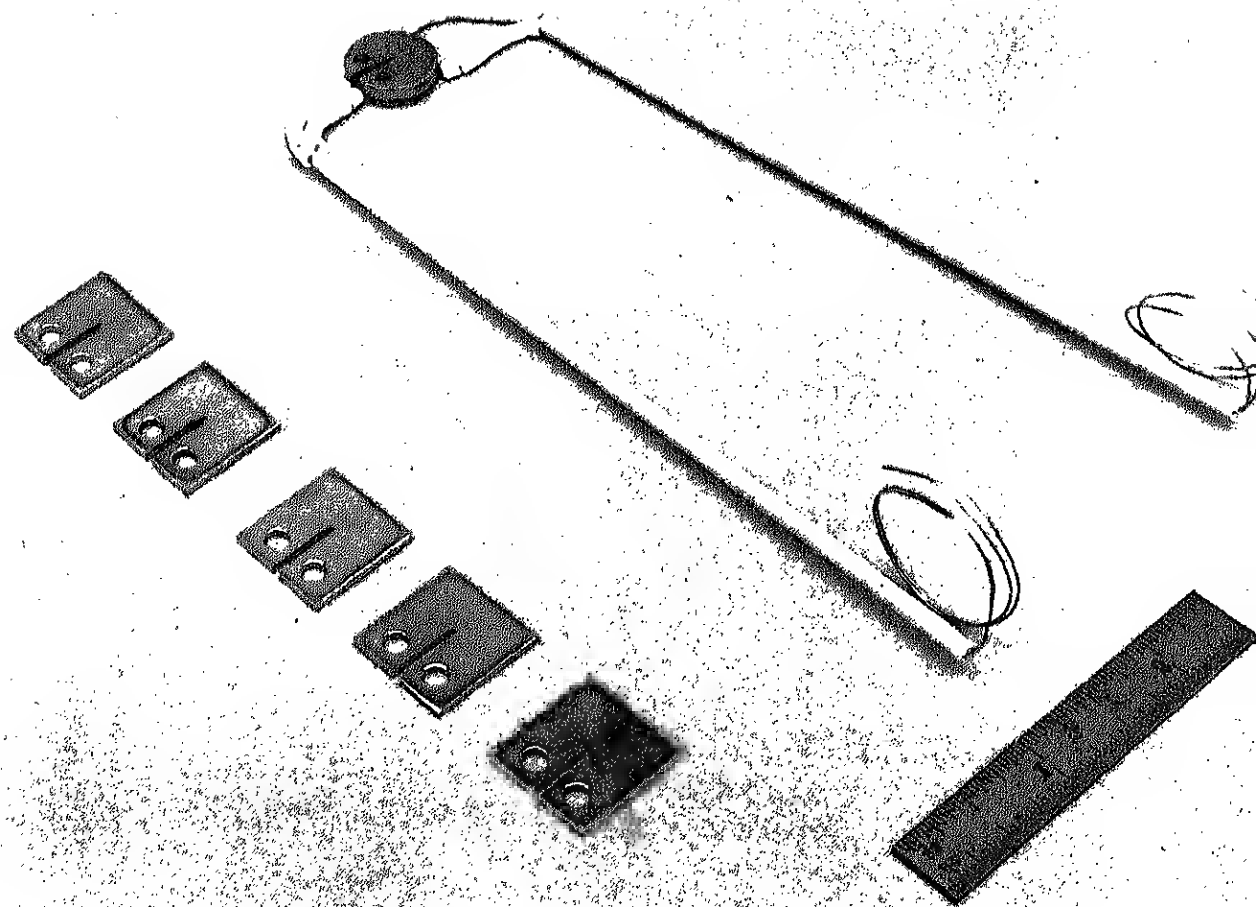
## **SCOPE**

Demonstrate capability of the Radioactive Acid Digestion Test Unit (RADTU) to process Z-plant waste, D&D waste, and special waste forms.

## **RECENT TECHNICAL HIGHLIGHTS**

High rate digester equipment was installed and tested to increase system capacity to 10 kg waste/hr. Centrifuge and air classification equipment was installed and tested. Radioactive operation was restarted in June, 1980.

International workshop on acid digestion was held at HEDL in October, 1980.



MAGNETIC FUSION ENERGY-5 (MFE-5) IN  
REACTOR FATIGUE CRACK GROWTH EXPERIMENT

## **OBJECTIVE**

Develop, characterize and qualify materials for fusion reactor wall applications.

## **SCOPE**

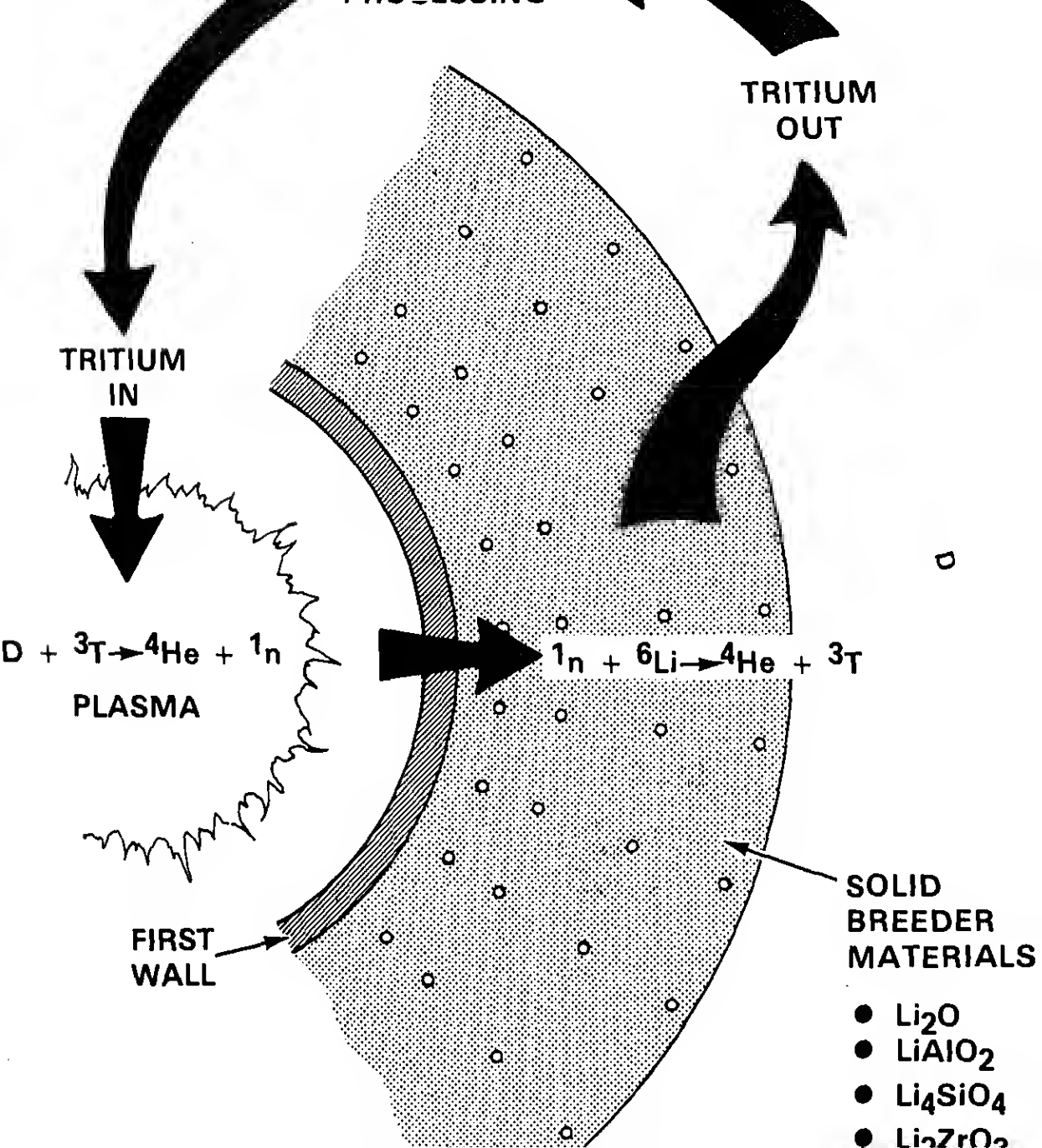
Test and analyze irradiated materials to determine fatigue, fracture toughness, swelling and creep.

## **RECENT TECHNICAL HIGHLIGHTS**

Fabrication of the world's first MFE-5 in-reactor fatigue and crack growth experiment was completed and the test assembly is ready for insertion into the Oak Ridge Research Reactor.

## **EXPECTED NEAR-TERM ACCOMPLISHMENTS**

Irradiation of the MFE-5 experiment in the Oak Ridge Research Reactor will be started. Post irradiation fatigue crack growth tests on titanium will be started.



**Manager:** E.T. Weber  
**Sub-Department:** Core Evaluation  
**FY-81:** \$ 200K

**Customer:**  
**Organization:** DOE/OFE  
**Contact:** T.C. Reuther  
**Program:** Fusion Reactor Materials  
AT-15-30-33

## **OBJECTIVE**

Develop, characterize and qualify blanket materials for fusion reactor applications.

## **SCOPE**

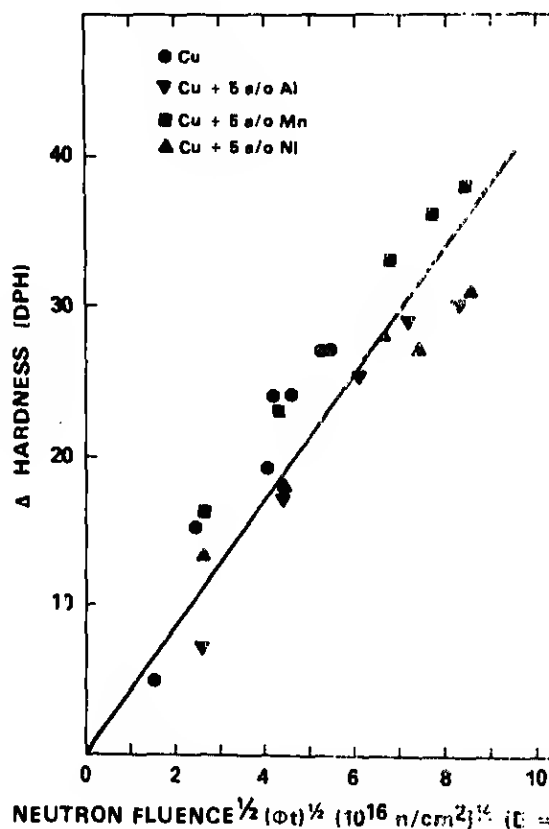
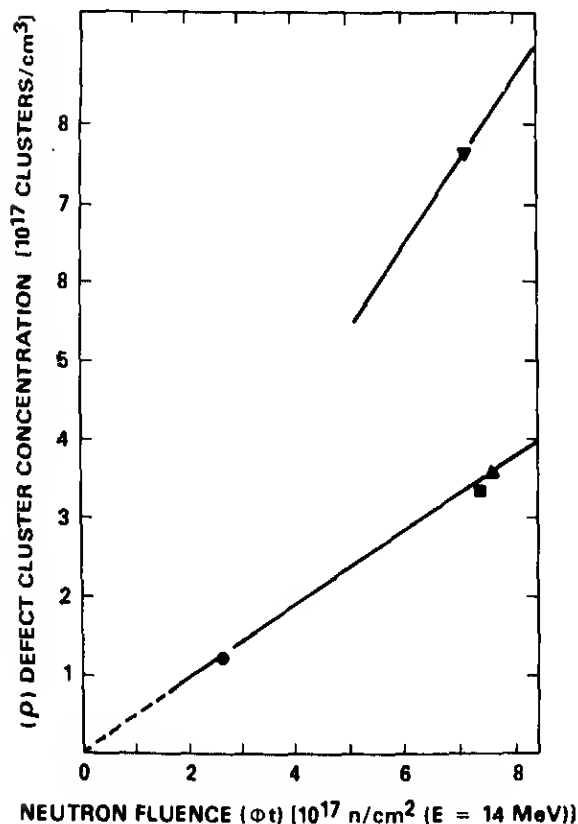
Fabricate, irradiate and analyze lithium ceramic materials for fusion blanket.

## **RECENT TECHNICAL HIGHLIGHTS**

Technical feasibility for a Fusion Breeder Materials Irradiation experiment in EBR-II has been established.

# INDICATES THAT ALLOY ADDITIONS INFLUENCE VISIBILITY OF DEFECT CLUSTERS

(14 MeV NEUTRONS; 25°C IRRADIATION TEMP.)





## **OBJECTIVE**

Clarify fundamental processes controlling material response to irradiation and develop correlations for extrapolation of fission-generated data base to fusion environments.

## **SCOPE**

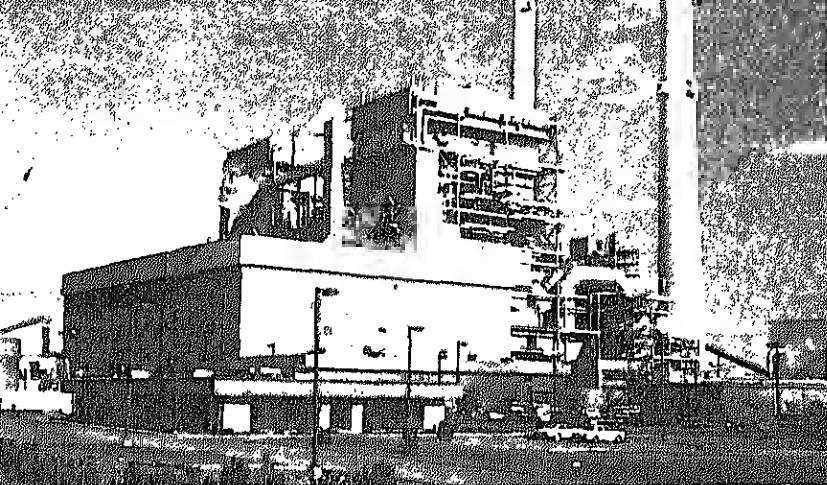
Analyze basic radiation damage events, model mechanisms of material response, and conduct experimental studies involving comparative fission and fusion irradiations.

## **RECENT TECHNICAL HIGHLIGHTS**

High resolution electron microscopy and recently developed microhardness measurement techniques were used to analyze the initiation of microstructural damage in specimens irradiated by fusion energy neutrons. A computer graphics capability was developed for analyzing atomistic damage models.

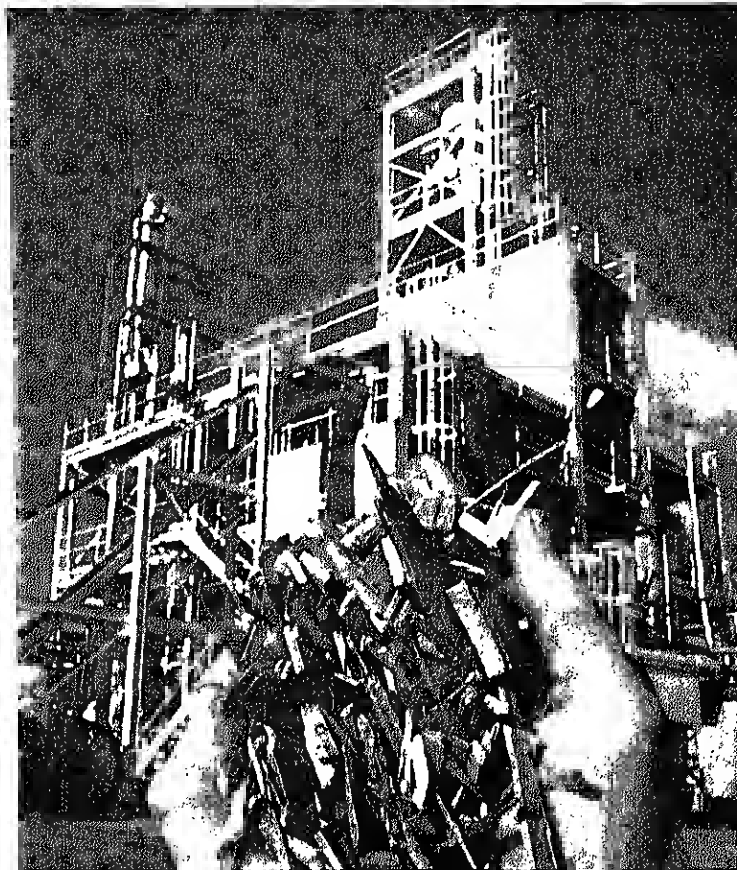
## **EXPECTED NEAR-TERM ACCOMPLISHMENTS**

Atomistic modeling of high energy neutron damage production will be extended to high energy events (several hundred KeV) and computer graphical analyses made. Electron microscopy will begin on specimens irradiated in Oak Ridge Research Reactor and EBR-II to determine helium effects on microstructure.



## **BIOMASS DEVELOPMENT**

Evaluation of  
pollution impact  
from non-point  
sources.



**FY-81:** \$ 25K

**Program:** Energy Assessment  
Impacts Program  
HA-01-03-04

## **OBJECTIVE**

Provide water resource data and analytical support for Energy Assessment Regional Impacts Programs.

## **SCOPE**

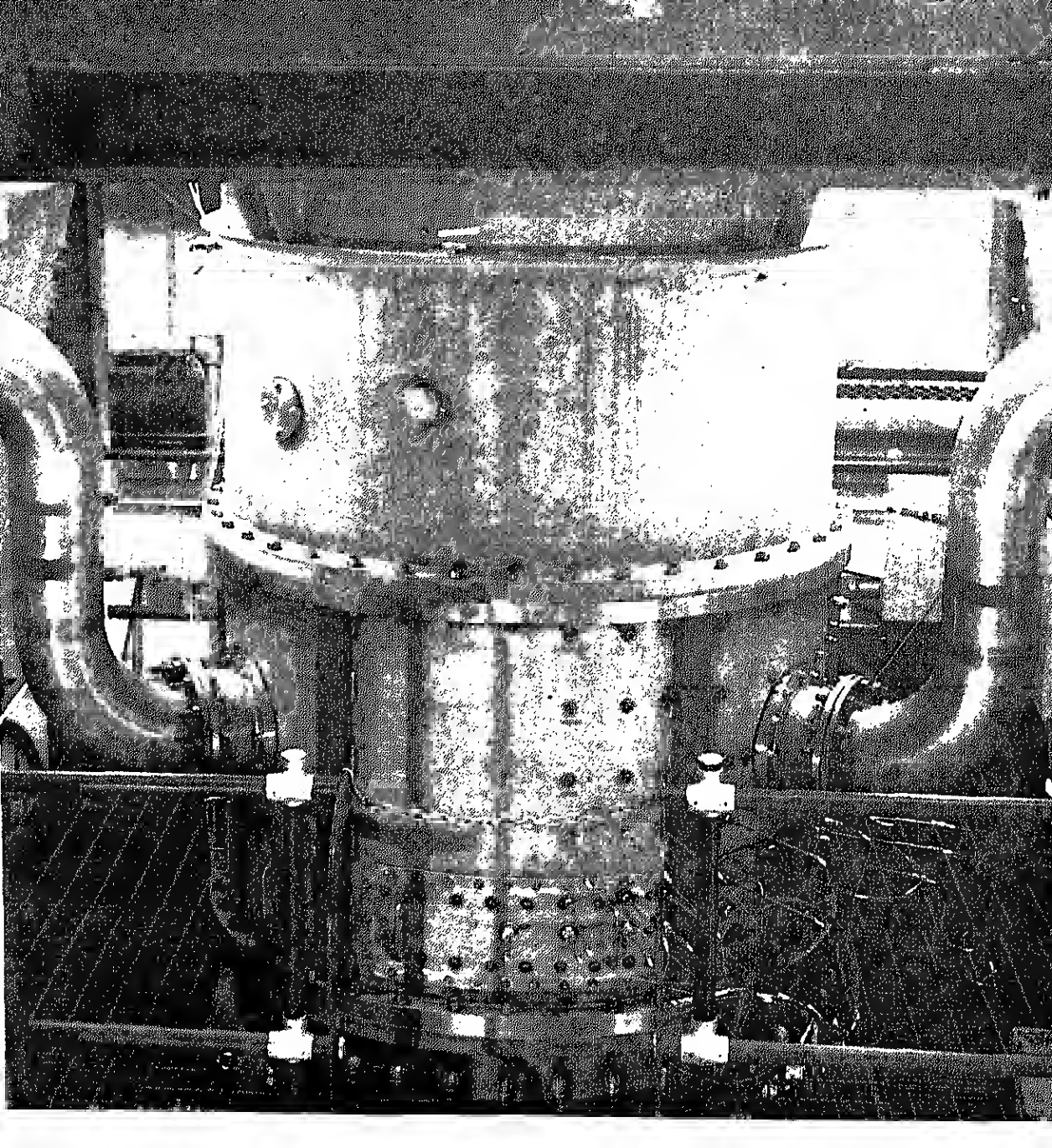
Evaluate the nature and extent of non point pollution impacts expected from energy activities.

## **RECENT TECHNICAL HIGHLIGHTS**

Requested evaluations and water resource data were submitted.

## **EXPECTED NEAR-TERM ACCOMPLISHMENTS**

Evaluation of pollution impacts associated with mining, synfuels development and biomass development will be completed.



**Manager:** W.L. Thorne  
**Sub-Department:** Technology

**FY-81:** \$ 890K

**Customer:**  
**Organization:** CRBRP  
**Contact:**  
**Program:** Special Request

## **OBJECTIVE**

Provide thermal hydraulic, vibration and mechanical testing of CRBRP reactor systems in accordance with Work Agreements L-274, L-294, and L-295.

## **SCOPE**

CRBRP Reactor Systems Testing at HEDL involves hydraulic and mechanical design verification test programs of reactor vessel internal systems including full-scale fuel and radial blanket assemblies, one-quarter scale inlet plenum and outlet plenum models, and other reactor vessel components under steady state reactor conditions.

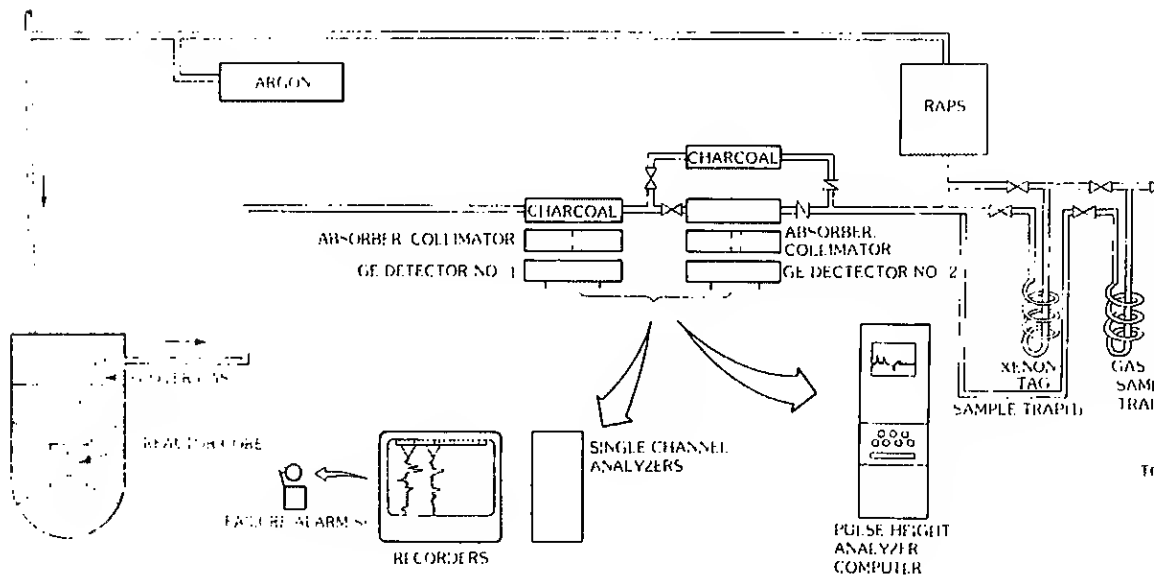
## **RECENT TECHNICAL HIGHLIGHTS**

Completed data reduction and analysis of the original CRBRP Integral Reactor Flow Mode (IRFM) Bypass Thermal Striping tests.

Performed initial CRBRP Duct Bending/Load Pad Strength testing.

Started flow and vibration testing on full scale prototypic CRBRP radial blanket fuel assembly.

# COVER GAS MONITORING FOR CRBRP - PRELIMINARY DESIGN



**Manager:** J.J. McCown  
**Sub-Department:** Technology

**FY-81:** \$ 90K

**Customer:**  
**Organization:** CRBRP  
**Contact:**  
**Program:** Special Request

## **OBJECTIVE**

Finalize basic parameters of cover gas Fuel Failure Monitoring sampling and analysis system. Provide engineering consultation services during preliminary design.

## **SCOPE**

Modify Prooftest Experiment, EX-154, at EBR-II and test suitability of modifications.

Develop computer codes that use mass spectrometric and radiometric analyses to locate and characterize fuel failures.

## **RECENT TECHNICAL HIGHLIGHTS**

Installed HEDL designed thick absorber in position #5 of Detector No. 2's device to improve very high count rate capability.

Tested modified Gamma Ray Subtract (GRS) software for use with compound absorber collimators and with thick absorber.



TRANSPORTATION OF SPENT FUEL IN  
LWR SHIPPING CASK



## **OBJECTIVE**

Assist in standards development and compliance evaluations for NRC by developing a computer simulation model of the mechanical response of radioactive material shipping packages.

## **SCOPE**

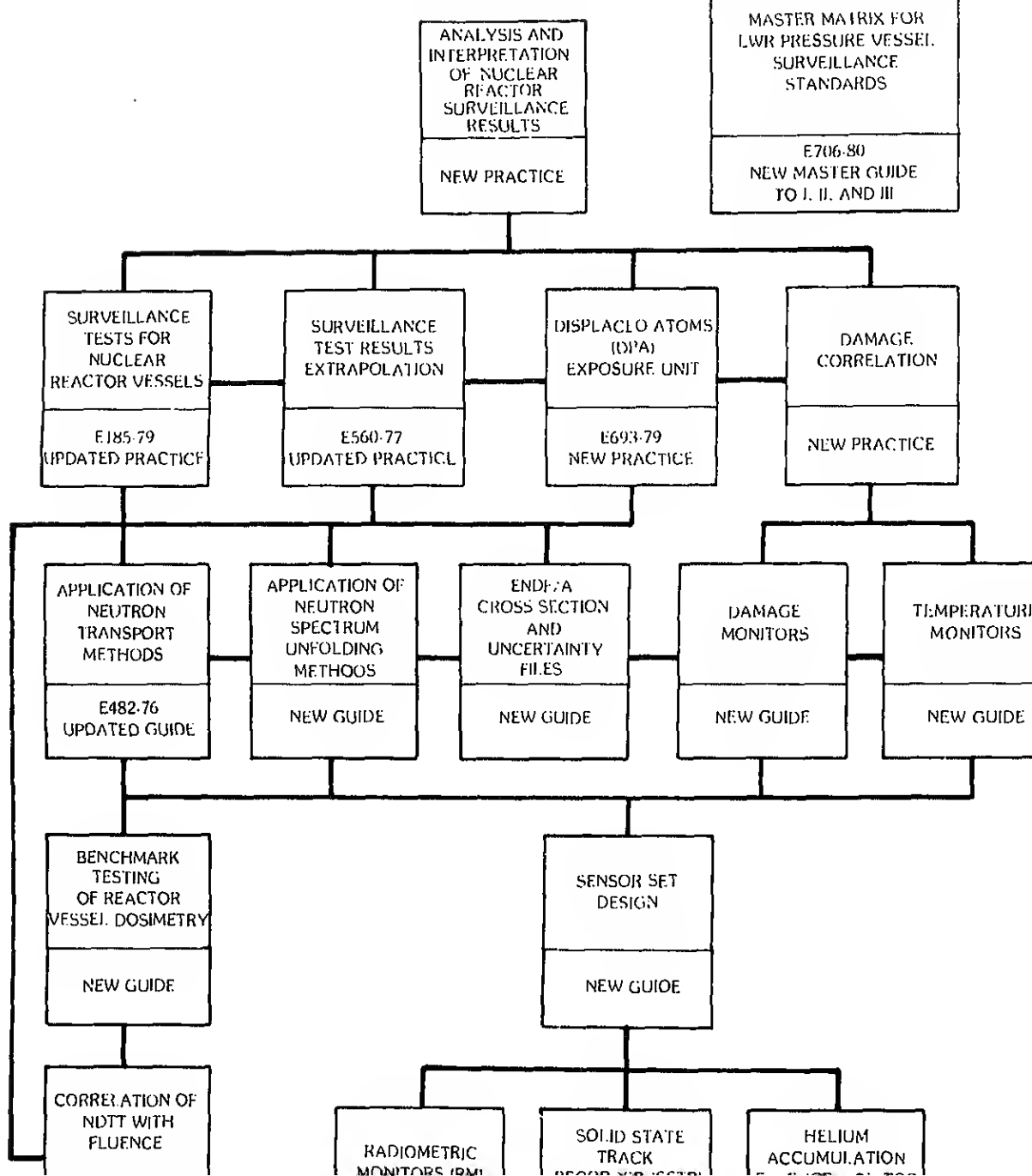
Develop computerized simulation model of mechanical responses of LWR spent fuel shipping casks in normal transport situations. Validate and parametrically extend the model; provide calculated results to apply to standards development.

## **RECENT TECHNICAL HIGHLIGHTS**

Preliminary validation of the computerized simulation model was completed. Parametric and sensitivity analysis were completed.

## **EXPECTED NEAR-TERM ACCOMPLISHMENTS**

Complete model validation. Extend parametric and sensitivity analysis and supply data and methodology for purposes of developing regulatory guidelines.



## **OBJECTIVE**

Establish updated and improved ASTM standards for LWR pressure vessel irradiation surveillance, dosimetry, damage correlation, and associated reactor analysis and interpretation procedures.

## **SCOPE**

Prepare and write 17 ASTM recommended standards.

Perform supporting analytical and experimental work: validation and calibration of the recommended ASTM standards using "Standard, Reference, and Controlled Environment Benchmark Neutron Fields," Reactor "Test Regions," and Operating Power Reactor "Surveillance Positions."

## **RECENT TECHNICAL HIGHLIGHTS**

Major physics and dosimetry studies in a low-flux level pressure vessel mockup at ORNL, including a "Blind Test" validation of physics calculations involving US and foreign participants, was completed.

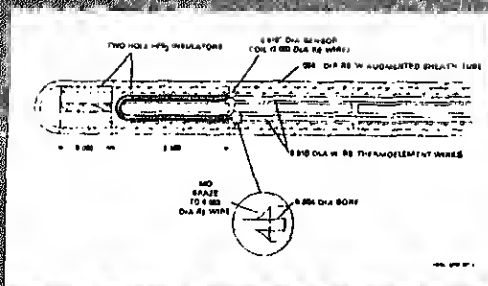
A two-year metallurgical irradiation in a high-flux level pressure vessel mockup at ORNL was started. A shorter irradiation of a mockup surveillance capsule was completed.

## **EXPECTED NEAR-TERM ACCOMPLISHMENTS**

Preparation and writing of key ASTM Practice, IA will be completed.

Analysis of samples from the metallurgical irradiation at ORNL will be started. This will validate the accuracy of using surveillance capsule data to make end-of-life predictions for the

# LOFT 2200°C FUEL CENTERLINE JOHNSON NOISE POWER THERMOMETER (JNPT)



SECTIONAL ILLUSTRATION OF SENSOR JUNCTION

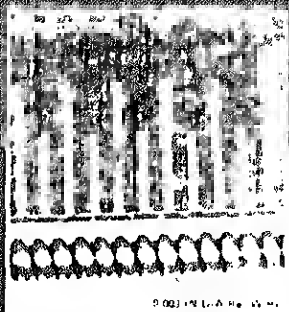
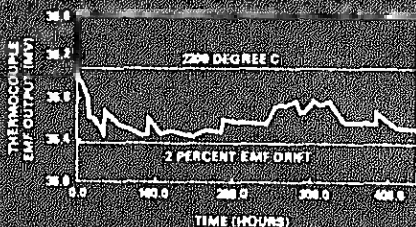
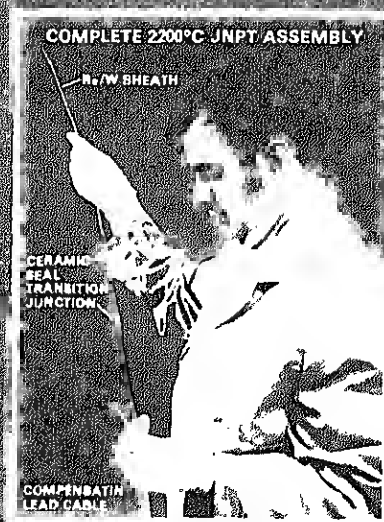


PHOTO OF SENSOR COIL  
0.010 IN. DIAMETER WOUND  
FROM 0.003 IN. R<sub>h</sub> WIRE



AS A THERMOCOUPLE, LESS THAN 2%  
DRIFT IN 400 HOURS AT 2200°C



- DUAL JOHNSON NOISE POWER THERMOMETER, THERMOCOUPLE CAPABILITY
- 4 FT., 1/16 IN. O.D. RUGGED R<sub>h</sub> WIRE PROBE, H<sub>2</sub>O<sub>2</sub> INSULATED.
- ABSOLUTE "IN SITU" CALIBRATION NOT EFFECTED BY REACTOR TRANSMUTATION EFFECTS.
- CERAMIC-TO-METAL SEAL TRANSITION JUNCTION PREVENTS FISSION GAS ESCAPE - HERMETIC TO 8°C/s THERMAL TRANSIENTS.

**Manager:** E.M. Sheen  
**Sub-Department:** Reactor Core Supply  
**FY-81:** \$ 164K

**Customer:**  
**Organization:** NRC  
**Contact:**  
**Program:** Special Request

## **OBJECTIVE**

Develop fuel rod instrumentation for NRC loss-of-flow tests (LOFT Program).

## **SCOPE**

Develop fuel centerline temperature measurement systems to 2200°C, fuel rod gap pressure sensors, axial motion monitoring sensor and fast plenum thermocouples.

## **RECENT TECHNICAL HIGHLIGHTS**

A fuel centerline temperature measurement system combining a Johnson Noise Power resistance coil and 2200°C thermocouple was tested in the laboratory. Vector signal analysis techniques improved fuel rod plenum pressure accuracy during temperature transients by a factor of 2.

SPENT FUEL ASSEMBLY

CONDENSER

FAN AIR OUTLET

VESSEL

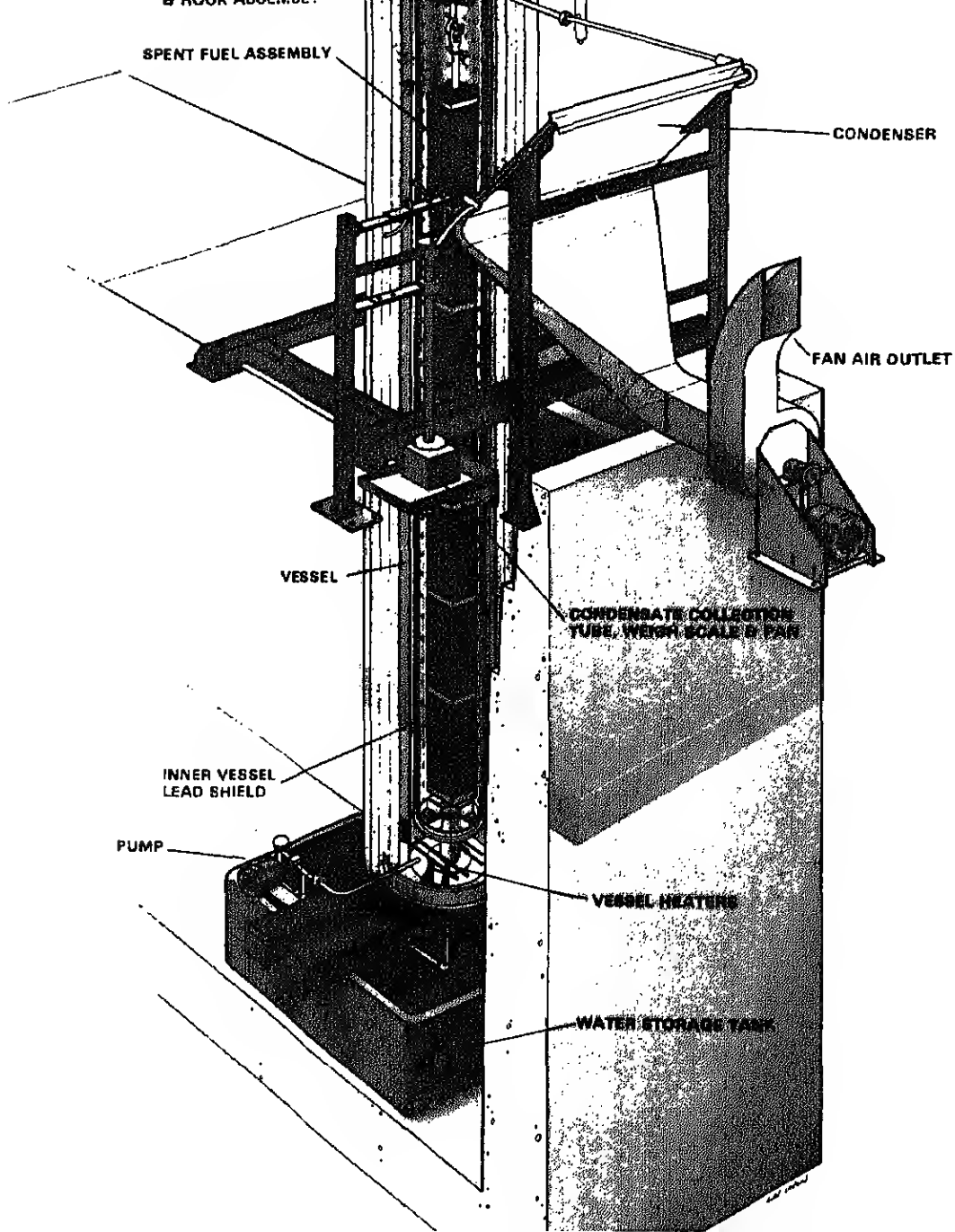
CONDENSATE COLLECTION  
TUBE, WEIGH SCALE & PAN

INNER VESSEL  
LEAD SHIELD

PUMP

VESSEL HEATERS

WATER STORAGE TANK



## **OBJECTIVE**

Develop technology to select and characterize Unreprocessed Light Water Reactor spent fuel waste forms suitable for isolation in a mined geologic repository.

## **SCOPE**

Develop data bases and theoretical and empirical correlations to characterize and describe the behavior of spent fuel after geologic emplacement in mine repositories. Identify, test, select and qualify stabilizer materials for isolating spent fuel rods in geologic waste packages.

## **RECENT TECHNICAL HIGHLIGHTS**

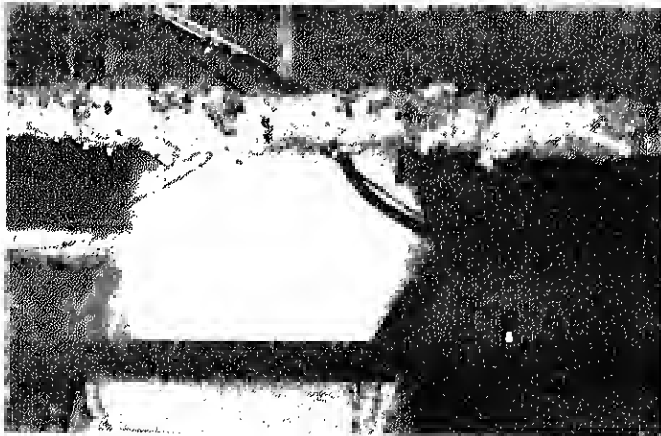
The first known decay heat measurement of a spent fuel assembly was successfully accomplished using a calorimeter designed, fabricated and installed at the Nevada Test Site by PNL and HEDL.

Results from initial elevated temperature whole rod tests show that significant stress relaxation occurs and stress rupture mechanisms can no longer be considered a primary mode for in-repository spent fuel breach.

## **EXPECTED NEAR-TERM ACCOMPLISHMENTS**

The Spent Fuel Engineering program at HEDL was redirected in FY-1981 to evaluate fuel waste form degradation mechanisms which affect long term resistance to release of radio-nuclides. This work will identify physical and chemical properties of spent fuel, theoretical and

# LITHIUM FIRE EXTINGUISHMENT



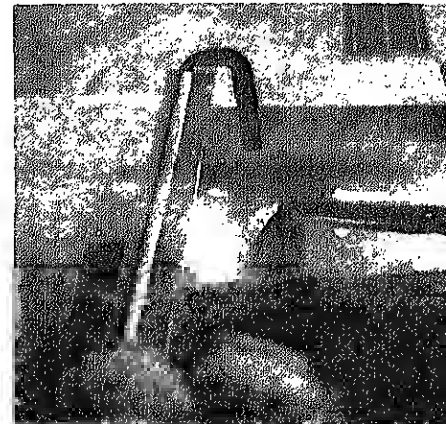
CARBON MICROSPHERES BY SPREADER



CARBONATE BASE POWDER



CARBON MICROSPHERES BY SPRAYER



CARBON MICROSPHERES BY HAND



**Manager:** L.D. Muhlestein  
**Sub-Department:** Technology

**Customer:**  
**Organization:** DOE/OFE  
**Contact:**  
**Program:** Special Request

## **OBJECTIVE**

Provide experimental data regarding the use of liquid lithium and alternative breeding and coolant materials in fusion reactors, and maintain research facilities to support safety analysis and design.

## **SCOPE**

Complete lithium reaction scoping studies to include lithium-atmosphere, concrete and insulating material reactions.

Develop and proof test lithium-reaction extinguishment and control techniques.

Determine lithium reaction aerosol behavior and develop and proof test effluent control concepts.

Complete alternate coolant/blanket materials interaction scoping studies.

## **RECENT TECHNICAL HIGHLIGHTS**

Completed lithium reaction scoping studies investigating reactions of lithium with various gaseous atmospheres, various types of concretes, and various insulating materials.

## **EXPECTED NEAR-TERM ACCOMPLISHMENTS**

Complete lithium reaction scoping studies to include lithium-atmosphere and experimentally demonstrate that